The travellers were robbed, and owe their lives simply to forced night-marches, gun in hand. They reached Kassala on February 12. Dr. Mook gives a sad account of the deplorable condition of the Soudan, where, as it seems, complete anarchy prevails.

THE United States Government is fitting out an expedition at San Francisco to search for the Arctic exploring vessel *Jeannette*, which has now been some months out. The revenue cutter *Corwin* has been selected for the duty, and she will start with one year's provisions. Her instructions are to search for two missing whalers also. The *Jeannette* went by what is called the eastern passage by Behring's Straits, and Capt. Markham, formerly of Her Majesty's ship *Alert*, of Polar fame, suggested that every year during the *Jeannette's* absence a vessel like the *Corwin* should be sent into the Arctic regions to save her or to learn, as the case may be, of her progress.

AN Austrian expedition, under the guidance of Dr. Otto Benndorf, Professor of Classical Archæology at the Vienna University, is about to start for Olympia. Besides Dr. Benndorf, Prof. E. Petersen (Prague), Dr. W. Gurlitt (Graz), some other member of the Vienna University, and an architect, will take part in the expedition. Dr. Wilhelm Klein, who has already started for Greece, will meet the expedition at Olympia. Another authority in archæology, Prof. Ernst Curtius, has also started for Olympia.

THE Dutch ship *Willem Barends* is being equipped for a third North Polar Expedition.

HERR ROBERT VON SCHLAGINTWEIT, the well-known traveller, has arrived at New York, whence he will proceed to Washington. He then intends to go on a scientific tour to the West of North America.

THE first sheet of a large prehistoric map of Bavaria, by Prof. H. Ohlenschlager, has recently been published. It comprises the district where, in the present day, Munich, Rosenheim, and Kempten are situated. The whole map will consist of fifteen sheets.

NO. 4 of Band xxiii. of the *Mittheilungen* of the Vienna Geographical Society contains the first part of an account of a botanical excursion to the Kasbeck (Caucasus) in the summer of 1871, by Peter Muromtzoff. At the monthly meeting of the Society, on April 27, a letter was read from Dr. Oskar Lenz from Tarudent, describing his passage of the Moroccan Atlas, in which he gives some interesting observations on the mountains and the people. Another letter was from Lieut. Kreitner, who accompanied Count Széchenyi in his attempt to penetrate Tibet through China. Lieut Kreitner states that he plotted carefully the whole route of the party and took many observations, while his companion, Herr von Loczy, took as careful note of the geological features of the region traversed.

L'Exploration for May 13 has the second of a series of articles on Central Japan, Yeddo being the subject of the present instalment; there is also a translation of Lieut. Bove's project of Antarctic exploration, the main points of which we have already given; the number also contains reports of the geographical societies of Quebec and the Argentine Republic, and numerous notes and news, the sources of which, we regret to see, are seldom acknowledged, their value thereby being much decreased. Under the editorship of M. Tournafond this journal is improving, though we think there is still much to be done ere it can be regarded as occupying a first place among geographical journals.

DR. HOLUB, the well-known African traveller, has opened an interesting exhibition at Vienna, which contains thousands of objects brought by him from the South African tribes. They are arranged in various groups, and are classified as zoological, botanical, mineralogical, archæological, ethnographical, and commercial objects.

THE PARALLEL ROADS OF LOCHABER—THE PROBLEM AND ITS VARIOUS SOLUTIONS[1]

AT a recent meeting of the Inverness Scientific Society and Field Club, and again at Fort William, in the immediate neighbourhood of the phenomena, a lecture was given on the above subject by Mr. William Jolly, H.M. Inspector of Schools, who has, for more than ten years, devoted great attention to the subject, and will shortly publish the results of his investigations.

Mr. Jolly thought the subject peculiarly appropriate for their Society, both on account of its intrinsic interest and the eminent men who had written of it, and the proximity of the Club to the locality exhibiting these singular and attractive phenomena. His aim was to state the problem, to explain the solutions offered, give its bibliography, criticise the theories, and develop more fully the one he adopted. He first described the locality of the roads in Glen Roy, Glen Spean, Glen Gluoy, and Glen Laggan, all at the south end of the Great Glen; and their unique and striking aspect, such as to draw the attention of the primitive Celts. They had received several names, being known in Gaelic as *Na Casan*, literally the feet, hence footpaths, of which Parallel *Roads* was a literal translation. Campbell of Islay's rendering, "The Bends," the Rev. Mr. McGregor, of Inverness, the Gaelic scholar, thought fanciful, and without foundation. They were also variously called "lines," "shelves," &c. The highest recognised is in Glen Gluoy at 1,172 feet, another existing there at 964; the three chief in Glen Roy stand at 1,148, 1,067, and 855; the lowest sweeping round into Glen Spean at the same level. A possible road, discovered by Darwin in 1838, in Glen Laggan, above the Loch Laggan Locks, is 1,300 feet high. Their breadth varies from 40 to 70 feet, giving an average of 60. They slope towards the valley at an angle of from 5 deg. to 30 deg., the hill face being inclined from 25 deg. to 40 deg.

Mr. Jolly then, by means of a printed diagram, which enhanced the clearness of the exposition, explained the Conditions of the problem, all of which must be satisfied by any theory claiming to be the true solution. These conditions were the following:—

I.—THE CONDITIONS OF THE PROBLEM

I.—*The Peculiar Form and Character of the Roads*

1. Their general horizontality and parallelism.
2. Their general equality of width (*a*) in the course of the same line, and (*b*) in relation to each other.
3. Their general continuity.
4. Their stair-like form, as of parallel layers laid successively on each other on the hill-side.
5. Their sloping towards the valley.
6. Their being proportionately narrower where they are steeper.
7. Their general absence where solid rock protrudes, and where the slope is exceptionally flat.
8. The *débris* of the hill above and below the Roads sloping more or less at the angle of repose.

II.—*Their Composition*

9. The absence of rounded, water-worn stones along them, and the general greater or less angularity of these.
10. Their consisting of the same *débris* as the rest of the hill-face, and not of transported matter.
11. The absence of cliffs, caves, and rock-notching, or any deep erosion, along their course.

III.—*Their Distribution*

12. Their sudden endings in all cases, without greater accumulations of *débris* or other indications of the cause of the same.
13. The symmetrical disappearance of the same lines at points opposite each other, in the same and *contiguous* valleys.
14. The outward extension of the roads, according to their lesser altitude.
15. Their occasional disappearance for considerable distances.
16. Their different altitudes in different glens, and the absence of the same lines in neighbouring glens.
17. Their being confined to Glen Roy and neighbourhood.

IV.—*Their Relations*

18. The existence of cols in connection with and slightly lower than each of the main roads.
19. The existence of other lines of a different character, above and below the roads. (Dwelt much on by Chambers.)
20. The existence of much terraced *débris*, below the roads, in the bottoms of the valleys containing them.
21. The relation of the roads to the glaciation of the district and its remains.

II.—THE SOLUTIONS OF THE PROBLEM

Mr. Jolly then expounded, by means of another diagram, the various theories proposed to satisfy these Conditions, and account for the Roads, naming the writers advocating them, with their dates, and the various works which they had written. All these are given here in the following table:—

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[1] By William Jolly, F.R.S.E., H.M. Inspector of Schools, Inverness.

	THEORIES.	WRITERS.		WORKS.
By man —Human.	Fingal	Old inhabitants.		
	Hunting roads of kings ...	Old inhabitants. Pennant	 1769	 Pennant's "Tour," 1771.
	Aqueducts for irrigation ...	Playfair	1816	Proc. Roy. Soc. Edin., 1816
By a flood —Diluvial.	... ...	Sir Geo. S. Mackenzie	1848	Edin. Phil. Jour., Jan., 1848.
		Prof. Rogers	1861	Lect. Roy. Inst., Lond., March, 1861.
By the sea —Marine.	... ...	Darwin	1839	London Phil. Trans., 1839.
		Lyell (visited 1825) ...	1841	"Elements of Geology."
		Chambers	1848	"Ancient Sea Margins."
		Rev. R. Boog Watson	1866	Geol. Soc. Lond. Jour., February, 1866.
		Prof. Nicol	1869	Geol. Soc. Lond. Jour., August, 1869.
		Campbell of Islay ...	1877	"Parallel Roads of Glen-Roy," printed privately.
By a lake—Lacustrine.	Nature of dam doubtful ...	Macculloch	1817	Trans. Geol. Soc. Lond., 1st series, vol. iv.
		Lubbock	1868	Geol. Soc. Lond. Jour., May, 1868.
		Babbage	1868	Geol. Soc. Lond. Jour., August, 1868.
		Rev. T. Brown ...	1876	Proc. Roy. Soc. Edin., vol. viii., March, 1876.
		Dakyns	1879	Geol. Mag., Dec., 1879.
	Dam of *débris* —detrital dam.	Dick-Lauder	1823	Trans. Roy. Soc. Edin., vol. ix.
		Milne-Home	1847	Proc. Roy. Soc. Edin., 1847.
		Do.	1876	Trans. Roy. Soc., vol. xxvii., 1876.
		Do.	1877	Trans. Roy. Soc., vol. xxviii., part 1, 1877.
	Dam of ice—glacial dam..	Agassiz (visited 1840) Buckland (do.)	1842 1842	Geol. Soc. Lond. Jour., vol. iii. 1842; "Atlantic Monthly," June, 1864 (Both by Agassiz).
		James Thompson ...	1848	Edin. New Phil. Jour., vol. xlv.
		Jamieson	1863	Geol. Soc. Lond., vol. xix., January, 1863.
		Darwin	1863	In private letters, &c.
		Lyell	1863	"Antiquity of Man."
		Archibald Geikie ...	1865	"Scenery and Geology of Scotland."
		Jolly	1873	Trans. Geol. Soc. Edin., April, 1873.
		James Geikie	1873	"The Great Ice Age."
		Sir Henry James ...	1874	"Parallel Roads of Lochaber," Ord. Sur. Off.
		Tyndal	1876	Roy. Inst., June, 1876; "Pop. Science Review," October, 1876.
		Prestwich	1879	Roy. Soc. Lond.; NATURE, May 29, 1879, in abstract; Lond. Phil. Trans., 1880, in full.

III.—THE SOLUTIONS EXAMINED

After referring to the Traditional theories of Fingal and the Hunting Roads, adopted by Pennant in his remarkable "Tour," published in 1771, he told how Playfair had seen similar appearances exhibited by irrigation works at Brieg, in the Valais, which suggested to him his curious solution.

The Diluvial theory held that they were caused by an immense flood from the Atlantic, through a sinking of the West Coast, rushing impetuously along these valleys. There was no use seriously criticising this theory, though adopted in 1861 by Prof. Rogers, of Glasgow.

The Marine theory had had many able supporters, from its first suggestion by Darwin, in 1839, to Campbell of Islay, so recently as 1877. The greatest exponent of this theory was Robert Chambers, in his "Ancient Sea Margins," published in 1848. He held that these lines were nothing but sea beaches, similar to those found so plentifully all over the country. He contended that other lines in these same glens were of the same kind; but these had been shown by Mr. Jolly, in 1873, to be entirely different in character, outline, and composition, and were probably moraines. Mr. Jolly then traversed the Conditions of the problem laid down on the diagram above, and showed how this theory violated, or failed satisfactorily to account for, Nos. 1, 4, 5, 7, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 21, each of which may be tested by the reader.

The Lacustrine theory would be found not open to the same objections. The great difficulty here was the nature of the dam, or barrier, that confined the waters of the lakes, of which the famous Roads were the successive shores or beaches. This theory was propounded, in 1817, by the far-seeing Macculloch, the eminent geologist, and early delineator of Highland scenery and geology; but he, along with others, had not condescended on the kind of barrier required. Two styles of dam had been contended for, the one of detritus, the other of ice. The Detrital dam, first suggested by Dick-Lauder in 1823, had been adopted by Milne-Home, who accompanied Robert Chambers to the region in 1847, and had written of it then, and twice since, with an amount of observation and detail that were of great and permanent value. These writers held that the lakes were contained by huge banks of *débris*, deposited by the sea and other causes, similar to that existing abundantly in many parts of the country. There was no doubt whatever that a large number of lakes, past and present, had been dammed back by such a barrier in many places; but if the roads were so formed, why were not such remarkable lines (whose character was unique) found elsewhere? Mr. Jolly here examined this theory in detail, in connection with the requisite Conditions, and held that it failed to satisfy many of them. How were these barriers so conveniently deposited at the required points, when the Great Glen, and the other valleys were, according to Milne-Home, filled with similar detritus? In the other lakes adduced by him, the outlets were *over the débris*, gradually wearing it away, while here they existed at the upper ends, flowing over hard rock. The roads ended abruptly on the hill face, with no remains of the asserted barriers, heaped up *at their extremities*, as might be expected, and was almost universal. How were the requisite great accumulations so effectively removed, reaching, as these must have done, to above 1,300 feet? The successive roads were on the same hill-face; so that the damming *débris* must have been wholly removed between the lines at their lower ends, before the new beaches were laid down. Mr. Jolly entered into other difficulties attending this theory, and finally concluded against it.

IV.—THE GLACIAL THEORY, AS ADOPTED

The Glacial theory was started by Agassiz, the great Swiss, who had been accustomed to the work of glaciers, after a visit paid to Lochaber in company with Buckland, in 1840. It has had the greatest number of adherents, Darwin and Lyell having also given up the Marine theory for it. Its chief exponent was Jamieson of Ellon, in an admirable paper published in 1863. Mr. Jolly, by means of a large survey map, variously coloured, entered into a careful explanation of the glaciation of the region. He held that the roads were produced by lakes dammed back by glacial ice, filling the lower parts of the valleys up to the ends of the roads, and gradually retreating with the ameliorating climate, *at the last stage of the second portion* of the Glacial epoch, immediately before the final disappearance of local glaciers from Scotland. The abundant rolled *débris* at the bottom of these valleys was laid down by former glaciers, and by the sea during the great depression in the *middle* of the Glacial period. He described the peculiar configuration of the Ben Nevis Range, with its parallel system of valleys opening out, on the south, to the close, deep Glen Nevis and its eastern continuation, and, on the north, to the broad Glen Spean and broader Glen More. The peculiarity of Glen Spean was that it would receive not only the abundant ice from the glens opening directly on it on the south, but also the greater part of the ice accumulated in Glen Nevis and its continuation, by the two outlets of Loch Treig and Glen Nevis itself. By this means, and by its special relation to the highest mountains in Scotland, it would receive an unusual supply of ice, equalled by no other valley in the country. This was proved not only by its geographical conformation, but by the superabundant glacial remains in the district, of which Mr. Jolly gave full details. During the first period of greater glaciation, the ice from Loch Treig, after entering Glen Spean, turned east down Loch Laggan, and west down the Spean; while Glen Roy itself was filled with an ice-stream from the same valley, which *moved out at its head, down the Spey*, as shown convincingly by the ice-markings there; and the Great Glen and its side valleys were also swathed in ice. As the climate improved at the *close* of the ice period, the glaciers gradually shrank backwards to their sources in the high Nevis glens, which, from their altitude and neighbourhood to the vapour-feeding Atlantic, would be the last in the country to preserve local glaciers. At that time, from its peculiar relations to these glens, Glen Spean would be filled from its head to the sea with a great ice-stream, resting on the *débris* already deposited by the sea, &c., and moving slowly downwards. This stream, entering the south end of Glen Roy, dammed back a lake there, fed by its tributary torrents, which has left its traces in the roads. As the ice gradually shrank in successive steps, the water subsided and the lake extended, as shown by these lines. Mr. Jolly here pointed out the position of the successive contractions of the ice required to dam the lake, and described the abundant evidences of this last stage of the glaciers there, in scratchings, carried blocks, boulder clay, &c., and in the splendid horse-shoe moraines of the Treig glacier, lying intact across and along Glen Spean. He held that the lowest road extended up Loch Treig only a short distance, suddenly ceasing there, and not round the whole lake—an additional remarkable proof in favour of a glacier then filling that basin down to the ends of the roads, where a dam was necessary. Similar remarks were made regarding the Glen Gluoy and Glen Laggan parallels.

By means of coloured additions laid over the map, the state of the ice at this period, necessary to fulfil the requisite conditions, was graphically exhibited. Mr. Jolly concluded with an appeal to the Society to study the fascinating problem on the ground itself, so as to help to a final settlement of the much-debated question. Inverness had already done honourable work in connection with it, for the height of the lowest road had been first determined by an Inverness man, Mr. Wm. Paterson, sent there for the purpose in 1847 by Mr. Joseph Mitchell, at the request of Mr. Robert Chambers.

Mr. Horne, of the Geological Survey, Banff, and others, afterwards spoke on the subject, and a cordial vote of thanks was awarded to Mr. Jolly.

The reader may consult with advantage, for the better understanding of the subject, the admirable maps of the district of the Ordnance Survey, both the six- and one-inch, in which the Roads and the related phenomena are accurately and fully laid down; or the special Ordnance selected map of the locality, appended to the paper of Sir Henry James, mentioned above.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The authorities of both Girton and Newnham Colleges have supported the general memorial of 8,500 persons in favour of the admission of women to academical degrees and examinations, by informing the Senate in detail of their past proceedings, the number of their students who have been examined informally, none of whom have failed to attain Tripos standards; and both colleges believe that they will be able to offer sufficient guarantees of stability and good administration, so that the University can admit their students to full academical privileges.

Newnham College has now been fully constituted, with Prof. Cayley as president. Prof. Adams has ably aided the Women's Educational Association during the last seven years as president, and now retires, on the amalgamation of Newnham Hall with it, retaining his place on the Council.

Mr. R. C. Rowe, of Trinity College, is appointed an Examiner in the next Mathematical Tripos, and Mr. A. G. Greenhill Additional Examiner.

Dr. Alexander Dickson has been appointed Regius Professor of Botany in the University of Edinburgh and Keeper of the Royal Botanic Garden of that city in succession to Dr. Balfour, who resigned some time ago.

The new representative Council of Education in France has been completed by the appointment of a number of official members. M. Berthelot has been nominated President by the Ministry. A number of sections and special commissions have been established, amongst which we must direct attention to the Commission for Reforming Secondary Instruction. One of the principal features of the intended reform is to divide secondary instruction into three different courses, so that any pupil leaving the school after having gone through the elementary course might have a general knowledge of the principal subjects which are to be investigated more fully in the other two courses.

The University of the City of Pesth celebrated its hundredth anniversary in presence of the Emperor on the 13th inst.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 4.—On the propagation of electricity through current water in tubes, and allied phenomena, by E. Dorn.—Thermic theory of the galvanic current, by J. L. Hoorweg.—On the cause of excitation of electricity in contact of heterogeneous metals, by F. Exner.—On diffusion of salts in aqueous solution, by J. H. Long.—On the relation between propagation of light and the density of bodies, by H. A. Lorenz.—On Stokes's law, by O. Lubarsch.—On after images of motion, by G. Zehfuss.—Supplementary note to the paper on currents of the Gramme machine, by O. E. Meyer and F. Auerbach.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 29.—"Measurement of the Actinism of the Sun's Rays and of Daylight." By Dr. R. Angus Smith, F.R.S.

When examining the air of towns and the effect of smoke and fogs, I have often wished for a very simple chemical method of measuring the total light absorbed by these gases, vapours, and floating solids. I do not undervalue the work of others, but I think I have obtained a process promising good results with great simplicity, although I daresay it introduces its own class of difficulties.

1. The fundamental fact is that when iodide of potassium in solution is treated with nitric acid, so small in quantity as to cause no change of colour in dull diffused light, a change takes place when the same mixture is brought into clear light; iodine is set free and the solution becomes yellow.

2. The amount of iodine freed can be titrated with great exactness by the use of hyposulphite, as is well known.

In these two facts lies the whole process: the first is the new part, the second makes the first quantitative, and its use is of course part of the novelty.

3. It is known that strong acid liberates iodine. Weak acid does so after a long time, but the process is hastened by light.

4. Heat even to the boiling point does not act so well as light (experiments being made in sealed tubes to prevent loss of iodine, and with a considerable volume of air).

5. Heat assists the action of light.

6. A solution may be exposed day after day so as to give the accumulated effect of sunlight, in a measurable condition at the end of the time.

7. The solution of iodide of potassium as hitherto obtained is subject to change. An old solution, that is, one nearly a month old, was found more sensitive than a new one in all cases tried.

8. The result of No. 7 is, that a certain allowance may require to be made for this, in those cases where the periods of observation with one solution are long.

9. The amount of allowance to be made for temperature is not made out. It is not certain that any is required in the cases when weak acid is used. The weather has not allowed any combined action of great light and heat, but with heat and light in the rays from an electric light with a parabolic reflector, the action was very rapid.

10. Specimens of experiments (prospective at first). It was found convenient to use a solution of 2 grms. of iodide of potassium, afterwards changed to 1 grm., in 100 of water, and to use half of this for an experiment, *i.e.*, 50 cub. centims. of the solution, which may be called A.

A nitric acid solution having an acidity equal to 1 per cent. of sulphuric anhydride was made; this may be called B. Only very small portions of B were added to A.

Examples in which the decomposition was measured by a solution of hyposulphite of sodium, which may be called solution C = 0·1 grm. per litre of iodine (or as convenient). I shall extract experiments made with B solution 0·8 cub. centim., because it is an intermediate one (·2, ·4, ·8, 1·6, and 3·2 have hitherto been the favourites).

1880.		B sol.		Measure by C solution (hyposulphite).
Mar. 3	Sunshine and cloud alternately	0·8	After $2\frac{1}{2}$ hours	8·1. First colour in 20′.
,, 4	Sunshine	0·8	—	First colour in 30′.
,, 5	Dull all day	0·8	,, 4 ,,	0·9.
,, 8	Sunshine	0·8	,, $2\frac{1}{2}$,,	7·5. Colour in 20
,, 9	A little sunshine ...	0·8	,, $2\frac{1}{2}$,,	4·8.
,, 10	Foggy, with a gleam of sunshine	0·8	,, 6 ,,	1·5.
,, 11	Bright	0.8	,, $2\frac{1}{2}$,,	7·2.
,, 12	Dull and wet	0·8	,, 3 ,,	0 6.
,, 13	Dark and dull	0·8	,, $2\frac{1}{2}$,,	Faint trace.
,, 15	Changeable	0·8	,, $2\frac{1}{2}$,,	1·8.
,, 16	Changeable	0·8	,, $2\frac{1}{2}$,,	1·6.
,, 18	Sun through haze ...	0·8	,, $2\frac{1}{2}$,,	5·8.
,, 19	Bright	0·8	,, $2\frac{1}{2}$,,	11·5.
,, 20	Fog till 11.30	0·8	,, $2\frac{1}{2}$,,	3·2.
April 1	Sun and showers ...	0·8	,, $2\frac{1}{2}$,,	1·6.